Facial Recognition, Configural Processing, & Concept Formation in HFA

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How Do The Brain & Mind Manage Information?
Face Recognition & Concept Formation

• Many individuals with autism have impaired face processing, which has been attributed to deficient configural processing or deficient prototype formation & expertise development.

• Many also have a remarkable focus on details w/o concepts. They learn detail-bound rules but not concepts that flexibly shift w/ context.
Cognitive & Neural Mechanisms: Common or Separate?

• The cognitive mechanism underlying both face processing & concept formation deficits might be generally conceptualized as a deficit in multi-dimensional information integration.

• But does this represent neural events? Or, is it more likely each depends on a similar & comparable mechanism represented separately in these two neural domains?
A Shared Underlying Mechanism?

• The purpose of this study was to investigate the relationship between face recognition abilities, configural processing, and concept formation abilities.

• In 36 HFA (FS IQ 106; VIQ 104; PIQ 106), aged 10-38 (x=18.9) years; 30 typical controls (FS 108; VIQ 107; PIQ 107), aged 10-42 (X=20.9) years, all w/ FSIQ & VIQ > 80.
Methods

- Dx autism: ADI, ADOS w/ clinical confirmation
- No identifiable etiologies or brain injuries
- No seizures, depression at testing
- Block Design subtest (BD) from WASI
- Embedded Figures Task (EFT)
- Benton Test Facial Recognition (BTFR)
- Vygotsky Concept Formation Test (VCFT)
Benton Test of Facial Recognition

- Ability to recognize faces by matching a target face with the identical face out of six options (identical front view, side views of the face, and a front view taken under different lighting conditions). 22 cards, 54 matches
- First 6 faces ask for one match each; last 16 faces ask for 3 matches each.
- Measure: total number correct (0-54)
  - HFA 39.6; TD 44.7, p<.000; 39-40 borderline; 37-38=moderate; <37 severe impairment (>41 nl)
Embedded Figures Test

• 12 test cards each with a different complex design with a simple shape hidden inside.
• Subject traces simple shape with stylus.
• Measure: # correct identifications out of 12 and time to complete:
  - HFA 938 sec vs TD 619 secs; p<.009
  - Total correct: 8 vs 10; p<.008 (used for multiple regression)
Modified Vygotsky Concept Formation Test

- **Convergent thinking**: group blocks by properties (narrow & tall; wide & flat...)
  - 4 tasks: errors, perseverative errors, cues, principles: NS

- **Divergent thinking**: sort by different principles (color, shape, height...)
  - Number of principles identified, total points for each principle: NS
Results

- BD: NS; EFT: $p=.008$ HFA performing worse
- BFRT: $p=.001$ HFA performing worse
- VCFT= NS
- Significant positive correlations between:
  - EFT total scores & BFRT raw scores $r=.43$ $p<.01$ in autism group only; no other correlations.
- Multiple regression: $dx (.002)$ & EFT .005 predicted performance on BFRT ($R^2=.31$)
Comments on Results

• Performance on BD and EFT often considered an index of local processing in HFA & HFA performance often superior to TD
• However, in HFA w/o intellectual disability no superiority found on these measures and, in fact, HFA perform worse than TD on EFT
• A deficit in face identity recognition was documented on BFRT.
Comments on Results

• No deficit in concept formation found with Vygotsky Concept Formation Test
• May reflect test limitation or our scoring of it
• May be a sensitivity issue in older HFA
• Hence, a comparison of face processing and concept formation deficits could not be pursued
Comments on Results

• EFT total scores & BFRT raw scores, $r = .43$, $p < .01$ in autism group ONLY; no other r’s
• Multiple regression: dx (.002) & EFT .005 predicted performance on BFRT ($R^2 = .31$)
Conclusions

• These findings suggest that the mechanism by which HFA w/o intellectual disability perform face recognition is different than the mechanism used by TD controls.

• HFA rely on limited local processing skills which may suffice for geometric designs but not for complex structures like faces.
Conclusion

• It was not possible to investigate the relationship between configural processing and concept formation.

• Evolving fMRI evidence suggests that the representation and flexible use of most knowledge depends on a distributed representation at encoding.
Abundance of white matter tracts:
to an even greater extent in left than right hemisphere
Maximally naturalistic
Poor correlation across autism individuals

A) Typical individuals
Correlation within the typical group: 0.32

B) Autistic individuals
Correlation within the autism group: 0.14

C) Average signal
Correlation between groups (average responses): 0.67
b. From folded to flattened representation

Folded brain  Inflated brain

Calcarine sulcus
Typical participants
(p=0.02, Random Effects, N=12)

Autism participants
(p=0.02, Random Effects, N=12)

Anterior Posterior

LH RH

FFA CoS LO

Anterior Posterior

LH RH

STS CoS LO FFA

Faces
Houses
Objects

CoS
Typical participants
(p=0.006, Random Effects)

Autism participants
(p=0.006, Random Effects)